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The role of transformation in learning and education for sustainability

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ABSTRACT

Education research has acknowledged the value of transformation, which offers an opportunity for researching and rethinking how appropriate and successful educational practices may be. However, despite the role of transformation in higher education and particularly in sustainability learning, there is a paucity of studies which examine the extent to which transformation and learning on matters related to sustainable development may be integrated.

Based on this perceived research need, the purpose of this article is to present how transformation in learning in education for sustainability requires the commitment of Faculty and the engament of students. To do this, a set of qualitative case studies were used in higher education institutions across seven countries (Brazil, Serbia, Latvia, South Africa, Spain, Syria, UK). The findings revealed that the concept of education for sustainable development has not been sufficiently integrated into the concept of transformation in higher education institutions. It also found that to enhance sustainability in the curricula, academics should develop collaborative approaches, and discuss how to redesign their own disciplines, and how to appreciate the epistemology and multicultural vision of sustainability, both as a topic, and as a field of education research. It was further found that reflections of the academics on their own values are crucial for developing the transformative potential of students as agents of a sustainable future. It is necessary that universities should transform to serve as models of social justice and environmental stewardship, and to foster sustainability learning.

1. Introduction: the role of transformation in learning and education for sustainability

Transformation in learning in education for sustainability requires the commitment of faculty and academics. With their efforts, motivation and innovative ideas, change in content and methods can materialise. Examples of whole curriculum reform and its reorientation towards sustainability are relatively limited (Von Blottnitz et al., 2015). It is worth highlighting that in HEI there is often no adequate institutional support and incentives for those academics willing to integrate SD in their activities (Hoover and Harder, 2014), and most of the efforts lie primarily on over-committed academics (Krizek et al., 2012). This implies that different perceptions and personal approaches to sustainability are

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integrated in these stand-alone courses, often with pedagogies not entirely appropriated to SD principles. Nonetheless, openness for interpretive flexibility and variations in practice have been indicated as essential to SD integration in a university context (Sammalisto et al., 2015). Furthermore, the combination of both strategies (whole curriculum reform and individual specialised courses) have been indicated as beneficial for embedding SD in Higher Educational Institutions (HEI) (Mulder et al., 2012).

The first debates about sustainability focused on the adoption of critical thinking based in the dynamic equilibrium between the economic, social and environmental spheres to create a better future (Elkington, 1998; Capozucca and Sarni, 2012; Kumar et al., 2015; Shnayder et al., 2016). In recent years, however, different authors emphasise the need to integrate non-traditional aspects of sustainability in the discourse. Ramos et al. (2015), for example, highlights the importance of defining sustainability frontiers to include new issues and paradigms to the traditional ones. The author stressed the inclusion of dimensions such as ethics, aesthetics and culture, also non-material values such as mutual help, solidarity and compassion are seen as emerging issues that have been neglected in previous approaches.

Individual values of academics in Higher Education Institutions (HEI) influence the content, learning outcomes and pedagogy used in teaching. Values play a key role in the way an academic will respond to proposals to educate for sustainable development and influence how their disciplines develope (Thomas, 2016). More recently, Burford et al. (2013) have identified three new aspects (cultural-aesthetic, political-institutional and religious-spiritual) based on less tangible dimensions of sustainability that can conceptualise a fourth pillar to add to the traditional ones. We need a new generation of professionals that think and take decisions within this new perspective and it is necessary to modernise higher education structures towards sustainability (Bilodeau et al., 2014; Leal Filho et al., 2015a, b).

These new perspectives reflect wider societal debates particularly concerning higher education. An increasing societal awareness on sustainable development challenges, as well as the urgency required to tackle them, contrast with limited progress in the integration of Sustainable Development (SD) in university curricula. Ramos et al. (2015) remarked that despite the efforts of many universities in integrating SD into the curricula, it has been recognized that changes have been little and that they have been occurring at a slow pace (Watson et al., 2013). Within this context, traditional sustainability approaches and teaching methodologies tend to be questioned. Moreover, capacity building and empowerment are crucial and support participatory approaches for transformation (Disterheft et al., 2015). For example, Howlett et al. (2016), Leal Filho et al. (2015a, b) and Remington-Doucette et al. (2013) pointed out that academics - need to rethink the organizational learning process to enhance students' understanding of the drastic consequences for human life resulting from the overexploitation of a planet with finite resources. The environmental (biophysical) dimension of sustainability has been traditionally overemphasized in SD curriculum integration. More holistic approaches stressed the importance of cultural-based approximations aimed at encouraging the understanding of the underlying causes of the unsustainability of current trends. As an example, an analysis of the political and cultural dimensions related to sustainability can facilitate a deep understanding of Earth overexploitation.

2. Transformation in learning and education for sustainability

The ideology of progress and growth, deep-rooted in western culture, not only justify Earth overexploitation (in the name of the continuous growth) but also affect the creation and collective construction of visions and narratives of a different and sustainable future (Lagnesjö, 2015). Transformative learning can benefit these approximations by stimulating students to critically reflect and question their assumptions and beliefs (Howlett et al., 2016). A shift from conformative or even reformative learning to transformative learning (a shift to higher order learning) will involve personal, institutional and political resistance by students that then poses a challenge to their beliefs and ideas, and a whole reconstruction of meaning (Sterling, 2013). Lewin (1951) and even John Dewey (1933), set foundational ideas in train for transformative learning. Argyris and Schön (1996) provided double loop learning concepts. And then Peter Senge's (1990)) learning organization ideas are also relevant and should be mined for additional insights about how university organisations could better tap into this field.

Participatory pedagogies that promote critical self-reflection that lead to transformed habits of the mind are the essence of transformative learning (Mezirow, 2000). Mezirow (1997) has stated that critical reflection is the key concept in transformational learning. Three types of reflection exist. Content reflection that is an examination of the content or description of a problem. Process reflection that involves checking on the problem-solving strategies being used and premise reflection that takes place when the problem itself is questioned. Mezirow's transformative learning theory (TLT) provides the theoretical foundation for the process to transform. The theory offers an explanation of the learning process underlying the journey to sustainable living. The value of connecting education for sustainability and transformative learning is that community engagement and the ability to deal with complexity and uncertainty are pursued (Ryan and Cotton, 2013).

In this new reality, universities should operate as knowledge and reflection institutions developing critical thinking and not only as teaching institutions that transfer knowledge. Howlett et al. (2016) emphasises the importance of critical thinking for sustainable development. There is a large agreement in the literature that critical thinking is an ability that can and must be taught (Schafersman, 1991). Universities have a strategic role in the world, especially in respect of sustainable development and their work to prevent a global collapse (Albrecht et al., 2007; Bilodeau et al., 2014; Ferrer-Balas et al., 2009; Glassey and Haile, 2012; Gudz, 2004; Howlett et al., 2016; Leal Filho et al., 2015a; b; Miller et al., 2011; Mochizuki and Fadeeva, 2010; Moore, 2005). Teaching, research, operations and relations with local communities should be thought of as activities integrated to reflect the principles of sustainability. According to Leal Filho et al. (2015a, b), about 600 universities around the world have adopted this new vision of education for sustainability.

The transformation in higher education towards sustainability should encourage inter and transdisciplinary approaches (Ferrer-Balas et al., 2009; Moore, 2005; Remington-Doucette et al., 2013; Sterling, 2013), the integration of theory and practice (Moore, 2005), the individual commitment and development of synergic actions in groups (Glassey and Haile, 2012; Mochizuki and Fadeeva, 2010), the ethical discussions and reflections (Biedenweg et al., 2013; Howlett et al., 2016) and the adoption of critical thinking (Ferrer-Balas et al., 2009; Howlett et al., 2016; Wooltorton et al., 2015). Integrating these issues requires and leads to innovation in pedagogical methodologies (Ortega Sanchez et al., 2018). A recently published volume devoted explicitly to transformation on sustainability (Leal Filho et al., 2015a, b) outlines the progress reached to date.

Disciplinary boundaries should be set aside, and the integrating of non-academic knowledge and expertise should be promoted. It is a difficult task to perform but, with persistence, it is possible to

obtain useful results in the developments of viewpoints (Barber et al., 2014; Howlett et al., 2016; Mochizuki and Fadeeva, 2010). Both inter and transdisciplinary research has demonstrated unique transformational properties (Lang et al., 2012). However, a transdisciplinary approach is increasingly accepted as necessary in addressing complex, multi-stakeholder real-life problems with high social and environmental relevance (Gaziulusoy and Boyle, 2013), such as those characterizing SD. One of the main reasons is the explicit integration of 'values' in the research process with a global concern with common goals and life in general (Max-Neef, 2005). These principles can be successfully integrated into innovative teaching practices. As an example, educators could explicitly integrate students in promoting debates without academic frontiers, where no knowledge or subject is regarded as more relevant than the other (Remington-Doucette et al., 2013).

Despite the lessons learned from best practices in implementing an inter-transdisciplinary approach by changes integrated into curricula, teaching and collaboration with community, threats to these processes are being identified within a number of studies regarding barriers to integration of sustainability in universities (Dyment and Hill, 2015). Roots of those challenges are often found in the traditional departmental, compartmentalised structure of universities (Savelyeva, 2012; Cortese, 2003) and its disciplinary boundaries (Moore, 2005b). Traditional division of sciences and disciplinary orientations in universities reflect general fragmentation of learning, still prevailing at all the levels of education and in various research areas, contradicting requirements from education and teaching to contribute to "transformation of society for XXI century". Self-reflection on transformative potential of universities and the role of teachers and other change actors is necessary but not sufficient for overcoming disciplinary barriers. The paradigm shift needs to take place in the sphere of policy and decision making, including the criteria for incentives to scientific research, still largely based on the traditional division of sciences and disciplines (Orlovic Lovren, 2016) as well as in the other segments of professional practice which rather than discourage, support interdisciplinary collaboration (Cortese, 2003). In efforts to bridge the gap between traditional and newly projected role of universities, authors often see the solution in the quality of teaching, adding significant responsibility to the already complex role of teachers.

Transformation should be directed towards more complex teaching epistemologies that recognise uncertainty and risk (Lotz-Sisitka, 2010). The university top management, in turn, should value the educators who participate in these initiatives, including these activities in the promotion plans and career development. According to Moore (2005), many universities have an exaggerated appreciation of the number of publications, leaving the undergraduate education in second place. These points to a skewed emphasis that would not contribute to transformation in learning and education for sustainability.

The integration between practice and theory can be done by two general forms: the approach between university and community and the use of the campus as a learning laboratory (Ferrer-Balas et al., 2009; Wiek et al., 2014). HEI can adopt the principles of Regional Centres of Expertise in Education for Sustainable Development that hold the potential to develop local or even global communities of practice for transformative learning for sustainability with social learning at its core (Wade, 2013). Inter-transdisciplinary working groups can list the problems experienced by the community and they can become topics to be debated in the classroom. Educators and students can use the theory taught in the discipline to perform the real projects mentioned (Barber et al., 2014; Ferrer-Balas et al., 2009; Wiek et al., 2014). Besides, the inclusion of students in the dialogue with communities can present opportunities to learn and understand different points of view (Too and Bajracharya, 2015).

Besides of the two general forms mentioned above, it is worth highlighting service-learning in the framework of internship programmes placing students in developing countries. They complement formal curricula activities including practical experiences in developing countries, in collaboration with international and local NGOs (Pérez-Foguet et al., 2005). These initiatives encourage students to put into practice the theoretical knowledge acquired and to find practical relevance in what they have studied in these sometimes 'extreme' experiences in southern countries. Boni et al. (2015) pointed out that these experiences have a strong impact on student's assumptions and worldview which usually can't be reversed.

It is relevant to mention that Bamber and Hankin (2011) indicate that student engagement through service-learning with local communities have a clear transformative potential for students, challenging their own stereotypes and personal values. The authors stress that these initiatives, conducted in a domestic context, are not dissimilar from those experienced by students involved in international service-learning initiatives. For this reason, they advocate a model of community engagement that embeds local service-learning within the curriculum, since a transformative redesign of educational paradigms that involves learning as change throughout the educational community is a shift towards higher order learning (Sterling, 2013).

Whole university approaches, connecting different functions such as teaching, research, campus operation and strategies aimed at communities and stakeholders' engagement and participation, have been indicated as essential for embedding sustainability in HEI (Lozano et al., 2015; Sterling, 2013). Efforts focused primarily in one specific function (only curriculum reorientation, for example) are partial and hardly facilitate a cultural shift to existing dominant structures and practices. Therefore, the implementation of educational strategies and initiatives aimed at transformation in learning should be harmonised with all university functions according to this approach. Campus operations should also be inserted in sustainability projects (Too and Bajracharya, 2015), since the students will not be motivated if they realize that the concepts taught are not applied in the reality (Gudz, 2004). A sustainable campus is a place where sustainability is part of the strategic decisions, the community participates with the university and the university tries to improve the community's life through problem solutions, the use of resources is minimized and the results are maximized (Too and Bajracharya, 2015; Moore, 2005). Many universities still have the perception that students learn the theory and must leave the campus to experience the practice, but the first contact to practical experience can occur within the campus (Gudz, 2004). Moore (2005) and Too and Bajracharya (2015) argue that the campus should be understood as a learning location. Universities should serve as a trial run for innovation through sustainable behavior. A sustainable university should serve as a model of social justice and environmental stewardship (Sterling, 2013).

The individual commitment and the development of synergetic actions are essentials to insert sustainability in higher education (Glassey and Haile, 2012) for both faculty and students. Integrating SD into academic activities requires an extra effort and motivation of academics, because of the need for change is not only in content but, above all, in methods and approaches that go beyond disciplinarily concerns (Cebrián et al., 2015). This implies shifts from traditional pedagogical strategies that can be enhanced through faculty learning communities (Natkin and Kolbe, 2016). The individual commitment of students should be developed along the graduation course and professors have an clear role in this development (Howlett et al., 2016), mainly through discussions and group actions. The principles of synergy need to be highlighted so

that the students understand that the results are better than the sum of the individual parts (Glassey and Haile, 2012). Albrecht et al. (2007) pointed out that when the discussions are conducted synergistically, the institution develops an organizational learning culture with new skills and capacity for action. The analysis of the lessons learned about educational experiences is essential for progress towards sustainability (Bilodeau et al., 2014).

This state of affairs suggests that leadership that ensures flexible and comprehensive strategies are needed. This is, among others, highlighted in the ability to listen and respect the ideas of students, teachers and university employees, in the ability to anticipate change, dialogue, act democratically, stimulate knowledge and creativity. The characteristics mentioned compose the transformational leadership. The concept of transformational leadership is defined by Burns (2003): when leaders and followers reach a high level of motivation and morality, we have the transformational leadership. When there is the commitment of the followers and they are led to surpass their own interests, by the objectives of the organization, with commitment and promoting changes and high performances, also are effects of transformational leadership.

Transformational leadership theory is an useful tool in a competitive business environment (Bass et al., 2003). This theory seeks to study how the leader behaves organisationally during phases of transition and how he develops ways to achieve a desired future. In transformational leadership, the leader is concerned and shows respect for employees; he is conscious of the individuality of each person. He focuses on developing employees' loyalty, trust and justice relationships and works to increase employee self-esteem, confidence and effectiveness (Rego and Cunha, 2007).

Biedenweg et al. (2013) regard ethical discussions as the central point for the inclusion of sustainability in undergraduate courses, since the disciplines rarely engage the students in deeper debates on ethical principles. The authors' value practices such as competitions for sustainable technology, visits to learn about sustainable practices and disciplines on environmental and social studies, but they believe that these practices should be done after ethical debates, when the students already have a moral framework to do critical analysis and make decision. The authors suggest that these discussions should include students from different backgrounds (exact, human, biological, etc.) and other stakeholders. Howlett et al. (2016) agree with the previous point of view and emphasises the importance of critical thinking for sustainable development. It is through critical thinking that the students understand different perspectives and find creative solution to all stakeholders.

As pointed by Howlett et al. (2016), transformation should occur among academics in the first place. Case study research is one methodological approach that can be used by academics to investigate situations of higher education for sustainable development. Case study research offers the possibility to research all participants and documents outside and among those concerned which prevent higher education institutions from significantly moving forward in the direction of sustainable development (Kyburz-Graber, 2016). Some unique examples of international efforts to create transformation in learning in HEI are described in the following case studies. The sampling is a convenience one, based on the usefulness to analyse the institutions in which the authors are based. The diversity of countries and context offer useful insights as to how transformation in sustainability is perceived and handled in a variety of settings and contexts.

3. Case studies: transformation in learning and education for sustainable development

In order to allow an assessment of the extent to which matters related to transformation in learning and education for sustainable development are taken into account by higher education institutions, a study was performed, and implemented. This entails a survey and documentation of seven case studies from different countries and type of universities, which provide an overview of the diversity of approaches and methods currently being used. Table 1 summarises the respective cases according to the different university functions/activities involved. It should be at the outset stated that the role of transformation in learning, in the framework of education for sustainable development, is difficult to assess. In this study, transformation refers to a process of questioning and redefining one's frames of reference, experiences and assumptions to generate new meanings and new visions of future. Apart from innovative contents and pedagogies specifically related to education for sustainable development, it is assumed that a more holistic integration of sustainable development principles in the different university functions leads to a higher awareness of the role played by different university actors, fostering cultural and transformational shifts to their learning frameworks and visions related to sustainable development.

The case studies will now be described in turn:

3.1. Case study 1- university of Latvia, Latvia

Latvia's national legislation supports sustainability learning in higher education by means of Law on Environmental Protection (as of 15 November 2006, "Section 42. Environmental Education) that states that environmental education and education for sustainable development shall be included in the mandatory curriculum of the subject or course standard in accordance with the specific character of each subject by coordinating and ensuring succession in different education field of study. The focus group in respect to education transformation and education for sustainability are teachers considering the significance of teacher training improvement for the overall level of education at school level. Another key element shaping the content and approaches of the education for sustainability is close relations with environmental education and recently climate change and global change education.

Sustainability studies are offered as electives in nearly all universities in Latvia, however the study time allocated is quite low (just some hours per week in 1 semester). In some of them, study courses on environmental education and education for sustainable development are a mandatory element of study curricula for all students. Specialised universities in Latvia (technical and medicine universities), which are oriented towards strictly monodisciplinary education in branches of science, medicine or technology see their specialisation as their main strength and are more reluctant to integrated education for sustainable development. In this respect the University of Latvia is a leading national university in respect to both support for transformation of the education and education for sustainability.

The formal responsibility at University of Latvia about education for sustainability is the Centre for Education for Sustainable Development which functions to coordinate activities with ministries (Ministry of Education and Science and Ministry of Environmental and Regional Development), NGO's as well as UNESCO – a key player in respect of education for sustainable development. As education for sustainability is mandatory at universities of Latvia, major efforts of the Centre are concentrating on the development of study materials and advancement of study methods, thus supporting the transformation process of the education at universities as well as active international cooperation amongst all activities including the Baltic University Program, European Network for Environmental Citizenship and others. The results of the activities of the University of Latvia are related to internationalisation of the studies and transformation of the study process to meet the

Table 1
Overview of the case studies.

Case studies	Campus operations/ management	Existence of a SD unit at the university	Learning and teaching for sustainability programme	Faculty professional development, pedagogical innovation related to ESD	Integrating sustainability in research	Outreach, external operations, partnerships with communities, governmental actors and NGOs
University of Latvia	X	X	X	X	X	X
University of Damascus (Syria)	X	X	X	X		
State University of Campinas (Brasil)	X		X	X		
Manchester Metropolitan University (UK)	X	X	X	X	X	X
University of Belgrade (Serbia)		X	X			X
Polytechnic University of Catalonia (Spain)	X	X	X	X	X	X
North-West University (South Africa)	X		X	X	X	X

challenges of the XXI century facing universities, however also the development of several study materials, support for student centered teaching of sustainability issues as well as greening of university campi.

3.2. Case study 2- University of Damascus, Syria

The major body governing the higher education sector in Syria is the Council for Higher Education, which is located at the Ministry of Higher Education. The Council has the power of deciding, implementing and evaluating higher education policy.

Through cooperation with the European Union, “sustainability” as a scientific concept has been emphasized in the curricula in Syria through specific actions and policies at different educational levels. Cooperation with European universities has been particularly fostered to encourage the interchange of different perspectives and experiences of integration of sustainable development in the curricula. This, in turn, has favoured the discussion and the reframing of teaching and learning strategies within a sustainability framework. As an example of this process of integration of sustainability principles in the curricula, a joint professional master's dual degree has been launched at the University of Damascus in 2009 in collaboration with the Paris Est Marne-La-Vallee University. Specifically, a part of the master's degree, the ‘urban project module in sustainable urban development’ has been developed and taught jointly by professors from the Est Marne-La-Vallee University and the planning and environment department at the faculty of Architecture of Damascus University (Bensahel et al., 2014).

Since 2011 Syria has gone through a period which has been disrupted by unrest and radical events. Despite the political situation, the emphasis on transformative learning towards sustainability in higher education can be seen through the active implication of staff members at Damascus University in academic activities such as: multiple teaching exchanges offered by the project, and the participation of University representatives in the urban project workshop at the Grenoble Urbanism Institute, that helped the Faculty to update and re-frame the academic processes and teaching methodologies related to the integration of sustainable development in the curricula. Among other insights, the experiences gathered revealed the need to link research to practice and change the educational discourse to foster learners ability to critically question their assumptions and frames of reference. Moreover, the students of Damascus University had the chance to interact with various active members around sustainable development issues and gain several skills like team work, doing analysis and discussing development proposals (Bensahel et al., 2014). This has enabled the creation of students’ awareness on different concepts related to education for sustainable development, such as: local and global vision, critical thinking, and systemic approach among others.

The Faculty of architecture of the Damascus University, through its academic and administrative staff has continued these innovation efforts towards transformation in learning in the most difficult time, through: a) the adoption and the progressive integration of the concept of sustainability in Master degrees, as well as other courses and graduation projects; b) the promotion of sustainability principles in the management of the university campus, for example by introducing some green elements into the main areas of the Faculty, aimed at fostering environmental awareness among academics and students.

3.3. Case study 3- State University of Campinas, Brazil

This case study aims to describe the educational practices used in a module focused on “corporate sustainability” offered in the School of Mechanical Engineering post-graduate program (State University of Campinas, Brazil). This case study was selected for the novel results it has been providing to students in terms of learning transformation. The main idea of this module is to debate the concept of sustainability with students, presenting non-traditional points of views, in order that students question their frames of reference by critically reflecting on their assumptions and beliefs. In this way, diverse topics related the role of enterprises in society are deeply analysed and discussed, such as corporate governance based on ethics and transparency and dialogue with stakeholders to determine their needs, among others. The methodology mainly includes open debates and critical reflection about different issues related to corporate sustainability. Discussions of two and a half hours usually begin by a brief introduction performed by a professor and then are followed with debates and presentations. Professionals with different backgrounds are often invited to participate to enrich the discussions, providing different perspectives on business and enterprise. It is common that after debates students report that the activities performed created a critical thinking tendency in their minds. As a final project module, students are asked to critically examine the model of a company in the light of the knowledge acquired.

The University foresees that it is necessary to provide a new vision to engineers about the sustainable management models developed by companies. The integration of sustainability principles in technical education necessarily requires students not only gaining knowledge but also skills and competences related to sustainability, such as the development of critical thinking, future envisioning, systemic thinking, as well as the questioning of one's own values. In this regard, the case studies have shown that the analyses of texts from different areas of knowledge dealing on the same subject can be an useful method. Also debating in the classroom, preferably with guests from different areas, enrich students' learning, through the questioning of perspectives, forms of reasoning and previous assumption on specific topics. Finally, the

practical projects, in which students critically analyse business management models, provided useful results in terms of re-evaluation and reframing of the role of the enterprise in the society. The practices mentioned above can contribute to the education of professionals within the concept of transformational leadership.

3.4. Case study 4- Manchester Metropolitan University, UK

At Manchester Metropolitan University, the environment management system includes areas on curriculum, research, engagement and staff development. (Tinker and Tzoulas, 2015). The university has developed policy frameworks that address education for sustainable development through different university strategies such as the learning, teaching and assessment strategy, the environmental sustainability strategy and the environmental sustainability policy. The Environment Team of the university also publishes a report through the annual statement.

Promoting professional development opportunities related to sustainable development is an effective way to engage university staff. In terms of staff development, the Centre for Excellence in Learning and Teaching provides complementary opportunities for staff involved in teaching at a range of levels. Firstly, the Teaching and Learning Essentials workshops on education for sustainable development are open to academics, associated lectures, graduate teaching assistants, and professional staff who support learning. These workshops include object based learning and introductory level activities as well as an outline of drivers for sustainable development at universities. Secondly, an accredited unit on education for sustainable development runs yearly. This unit is part of the postgraduate certificate that all staff are required to complete. Finally, the centre has a set of online resources on the topic available to university members and externals. These include good practice exchange videos with examples of integration of education for sustainable development in the curriculum. These activities are aimed at providing professional training not only focused on sustainable development concepts and principles but also on appropriate teaching methods and approaches. The pedagogies employed in professional development courses promote a holistic perspective and multi/interdisciplinary approaches in the implementation of sustainable development in the different universities functions. Training insights and tools will then be used in practice, in order to plan and reorganise university curricula.

Although at Manchester Metropolitan University there is a breadth of initiatives in different departments that can be related to transformative learning, which have links to education for sustainable development, this brief case study will focus on some specific examples. An interdisciplinary project with undergraduate students of the School of Art and the Engineering Department was created aiming to engage them in activities focused on problem-based learning and community service learning focused on wool production in the Northwest of England (Fernando et al. (2014). The interdisciplinary approach and the engagement with authentic situations with local communities on sustainable development issues related to local production, represent the teaching and learning innovative aspect of this project. Students from these two disciplines rarely have the opportunity to collaborate or interact. These conditions favour transformative learning processes, helping students to integrate different values and perceptions of sustainability into personal and professional life. This, in turn, will encourage the creation of new meaning and values, as well as the processes of reframing of personal references and assumptions on sustainable development.

Some students engaged beyond the duration of the project, and one achieved writing a full paper for conference presentation. The project was winner of the Global Dimension in Engineering Education European award, a European initiative aimed at promoting sustainable development in engineering (Pérez-Foguet et al., 2005), for its innovation and multidisciplinarity.

Other examples of attempts at engaging students at Manchester Metropolitan University in transformative learning and education for sustainable development include initiatives in the Art School, in fashion (Langdown and Vargas, 2015) and in art and design (Cocchiarella et al., 2016).

3.5. Case study 5-University of Belgrade, Serbia

Opportunities for the reform of higher education in the University of Belgrade have been improved after the adoption of the Bologna principles and the Copernicus Charter. These processes opened new windows for applying interdisciplinary principles in developing and improving curricula, and for transformation towards sustainability (Orlovic-Lovren et al., 2016).

Research analyses are showing positive changes in terms of incorporating environmental and sustainability issues into curricula in institutions belonging to the University of Belgrade. While environmental issues are traditionally more common in curricula in science faculties, some steps forward have been made in the faculties of social science, at least at postgraduate level (Loncar, 2011). Changes are predominantly taking place in curricula and are still modest, but significant if we bear in mind the national context and consequences of recent political and economic transition (Orlovic-Lovren et al., 2015).

Very few examples of the integrative approach to sustainability are found in the University of Belgrade. One exception may be recognized in the Faculty of Political Science, where, beside the introduction of sustainability principles in interdisciplinary courses in Social and Political Ecology (Nadić, 2011), the Centre for Ecological Policies and Sustainable Development has been established. Its aim is to perform research, educational, cultural and publishing activities. In 2011, this Centre held a symposium on sustainable university development. (Pavlovic, 2011). In the same year, the “Sustainable Habits for Sustainable Development“project has been implemented, with the aim of raising awareness of sustainability issues among Serbian citizens (primarily youth) and encouraging changes in their everyday activities (Pantelic, 2011).

Development and implementation of a systematic approach to such improvements should be supported by the involvement in the international Inter-University Sustainable Development Research Programme (IUSDRP), joined by the University of Belgrade in June 2016. While the transformation of curricula is still reduced to individual subjects/courses or faculties within the University of Belgrade, there are recent positive signs of increased activity of students and professors on the research projects or promotional campaigns, aimed towards better understanding of sustainability and the role of students and teachers in achieving sustainable development goals. Part of those initiatives are undertaken in the Faculty of Philosophy and Faculty of Safety in 2017/8, where students, supported by professors – members of the University's Coordination body of the IUSDRP – jointly performed the research on students' perceptions of the faculty environment and sustainability issues. Their future cooperation on sharing these results with wider audience and discussing their future actions might be a modest but significant step in the transformation path towards increased sustainability of the University of Belgrade and its surrounding community.

3.6. Case study 6-Polytechnic University of Catalonia, Spain

In the last decades, Polytechnic University of Catalonia (UPC) has been proactive in promoting SD in its internal functions as well as

through the active collaboration with local communities. Overall, it can be described a progressive trend towards SD through different initiatives fostered since 1996 and aimed at integrating SD principles in university policies and strategies. Different environmental plans (Ferrer-Balas, 2004) as well as a specific corporate strategy, the 'UPC Sustainability Plan 2015' (Ferrer-Balas et al., 2009) have been implemented, during the last decades, with the aim of integrating SD in education, research and campus operations, progressively integrating a holistic perspective.

Contextually, education for SD has been strongly promoted through complementary initiatives focused on engineering students. From one side, the integration of the transversal competency 'Sustainability and Social Compromise' (Caetano et al., 2015) is currently mandatory in all courses of bachelor and master of UPC. From the other side, the promotion of specific academic programmes focusing on sustainability, such as the Master of Science and the Doctorate programme in Sustainability. Furthermore, the research in SD at UPC has been fostered through the creation of the Research Institute for Sustainability Science and Technology, catalysing research initiatives of UPC in SD.

The processes enabling transformation in learning towards sustainability largely depend on the competencies and the engagement of academic staff. Coherently, UPC during the last decades has been promoting continuing professional development of academics in SD through innovative training initiatives addressed specifically to engineering faculty (Pérez-Foguet et al., 2005). These efforts have recently resulted in a European initiative leaded by UPC, the Global Dimension in Engineering Education (GDEE), aimed at increasing the awareness, critical understanding and attitudinal values of students in technical universities related to Sustainable Human Development (SHD) and its relationship with technology (Trimingham et al., 2016). Attempts of transformation in learning have been focused on integrating SHD as a cross-cutting issue in teaching activities by improving the competences of academic staff and through engaging both faculty and students in initiatives related to SHD, through the active involvement of Non-Governmental Organisations (NGOs) in academic practices. The learning experiences promoted through this initiative have fostered in the deepening and the critical reflection of different concepts and principles related to the education for sustainable development and leading to reflective and transformation processes such as: local and global vision, critical thinking, participatory learning, partnerships, etc.

This transdisciplinary learning approach, extensively described in (Pérez-Foguet et al., 2018), highlighted the fact that the cooperation between NGOs and academia can be a critical factor in reinforcing the presence of SHD in formal teaching programs at all levels of engineering education. Specifically, the involvement of non-academic experts, such as NGOs practitioners, in formal teaching activities, contributes to enrich students' learning experience challenging their assumptions and creating new meanings, as well as to strengthen different competencies related to sustainability of both students and academic staff.

In spite of all the initiatives described, currently at UPC only a reduced number of university educators and researchers are actively involved in promoting change towards sustainability in their academic functions (Lazzarini et al., 2018), and more efforts are needed to foster more holistic and complex transformations towards sustainability.

3.7. Case study 7- North-West university, South Africa

The North-West University (NWU), is a member of the Association of University Leaders for a Sustainable Future and a signatory of the Talloires Declaration. To reinforce the latter, it incorporates sustainability and environmental literacy in teaching, research, university operations and outreach. With the aim of reducing the ecological footprint of campus operations and fostering the promotion of sustainability principles in university management staff and students, the Institutional Office has made provision for paperless meetings, as well as the recycling of paper, glass and plastic on all three campuses.

The Faculty of Education Sciences at the NWU has especially progressed towards transformation in sustainability learning through different initiatives that concentrates on different dimensions of pedagogical innovation related to education for sustainable development. Firstly, education for Sustainable Development has been included into the learning and pre-service training of the Bachelor of Education program. A compulsory module that deals with environmental management for sustainability forms part of the program for teacher training from Grade R (a reception year before Grade 1) through to Grade 12 (the final year of formal secondary education). Secondly, a further reinforcement of transformation in sustainability learning and teaching is found in the compulsory Work Integrated Learning (WIL) module featuring an academic environmental education project-/problem-based assignment marrying teaching strategies with praxis. Both modules address the fundamental principles of the curriculum where environmental and social justice, as well as the value of indigenous knowledge systems is reinforced. Students from across faculties are involved in a green committee. They organise and partake in social and educational initiatives to promote the concept of sustainability across campus relating activities to environmental calendar days and trending social and environmental issues. These complementary initiatives are particularly useful to foster deeper reflections and discussions on environmental and sustainability issues among students. This learning experience involves transformations in meaning perspectives and frames or references, leading to more open and personal interpretations of sustainability challenges. Finally, within faculty a research niche has been established with the aim of attending to environmental education for sustainable development. The niche focuses on the incorporation of sound environmental management systems into the management of schools that includes management of schools, pedagogy and learning environments following a whole-school approach. The research niche also focuses on critical environmental issues such as climate change, biodiversity, disaster risk reduction, sustainable consumption and production. The latter are emphasized in the curriculum to support sustainable development. The role of environmental values, practices of citizen scientists, and local ecological and indigenous knowledge for societal transformation to create a more just, peaceful, tolerant, inclusive, secure and sustainable world is also researched. Short learning programmes (short courses for which in-services teachers acquire professional development points accredited by the South African Council for Educators) are presented by faculty lecturers for teachers across the country and are certified by the NWU.

4. Lessons learnt from the case studies

There are evidences that sustainability is a key element in some HEI and that many concerted efforts are evident from literature (e.g. Leal Filho, 2015) and the case studies presented, despite the numerous remaining barriers. A deduction from the case studies is that the concept of education for sustainable development has not been sufficiently integrated into the concept of transformation of higher education. Considering the various institutional barriers and limited capacity to integrate sustainability concepts in the curricula of each study program, was also identified.

During the remodeling process of educational methods, to insert

sustainability concepts, many barriers will need to be overcome by educators, such as lack of awareness about the importance of the issue or abstract approach by educators with a conservative mentality, resistance of some university members, lack of funding to support sustainable activities, few financial rewards to educators participating in transformative schemes, individualistic approaches to research, and the existence of bureaucratic systems that hinder the flexibility and the undertaking of integration activities (Ferrer-Balas et al., 2009; Fisher and McAdams, 2015; Velazquez et al., 2006).

The development of sustainability science (a truly interdisciplinary science) could help to increase the credibility of sustainability learning in the eyes of more conservative academics, and may help to facilitate its acceptance. The implementation of the emerging education approaches into the content of education for sustainable development can be considered as a tool to support sustainability learning. The incorporation of sustainability education in academic activities is specifically promoted through the better understanding of different global issues related to sustainable development, such as: extreme poverty, human rights, globalisation, equality issues, professional ethics and environmental challenges. The benefits of this approach, linking theory with practice, is that it can help students make links to the real world, encouraging them to think of themselves as global citizens and thus promote a sense of global social responsibility.

Thus, each university should develop its own model to redefine the curricula of their courses and to promote integrative approaches, and there is no set formula to do this (Fisher and McAdams, 2015). One effort currently been made, is the set-up of the "European School of Sustainability Sciences and Research" (ESSSR) at the Hamburg University of Applied in Germany, which will act as a reference centre for research, teaching and training on matters related to sustainable development. The ESSSR works in cooperation with various universities, and among other things it aims to promote a better awareness of the role of sustainability science in transformative processes.

Bearing in mind that improvements at higher education institutions, especially but not only in the curricula have been mostly initiated by individual teachers or departments (and not always ast part of the sustainability policy of an institution), there is an obvious need for harmonisation of approaches to sustainability at country level. But in order to achieve this and put all universities at the same playing field. it is necessary to strengthen capacities for teachers, university staff and students, to apply an integrative approach to sustainability (Orlovic-Lovren et al., 2015), and foster the appreciation of epistemology in a teaching environment (Bilodeau et al., 2014; Howlett et al., 2016; Moore, 2005).

In the case studies analysed, it is also possible to observe the relationship between transformational leadership and innovation in education, as Oliveira (2017) argues. Innovative experiences for universities have been developed. Marques et al. (2013) emphasise the importance of an innovative culture higher educational institutions. Leithwood and Jantzi (2006) point out that the leadership that correlates with processes of change and innovation is the transformational leadership. This kind of leadership was observed in the case studies analysed. Burns (2003) reinforces that transformational leadership generates significant changes in society, in the behaviors and attitudes of the components of the Institution of Higher Education, achieving the objectives that have been proposed to it, obtaining the empathy and commitment of the people.

Mochizuki and Fadeeva (2010) point out that the existence of good practices developed by other institutions can have great value in the process of structuring and transformation of education. The works of Bilodeau et al. (2014); Ferrer-Balas et al. (2009), Glassey and Haile (2012), Holmberg et al. (2012), Sterling (2013), Wooltorton et al. (2015) and Howlett et al. (2016) present examples of good practices implemented in attempt to restructure higher education towards sustainability.

It is worth highlighting six main lessons: 1) it is essential to help students to develop a critical understanding and change in attitudinal values about global SD challenges; 2) students and faculty can strongly benefit from the cooperation with civil society organization in the integration of SD; 3) the critical analysis of case studies focused on SD, based on real projects implemented by NGOs, help students make links to the real world and contextualise theory; 4) the involvement of non-academic experts (such as NGOs practitioners) in formal teaching activities, enrich students' learning experience; 5) the capabilities of academic staff to support learning transformation processes are too often assumed, and more attention should be devoted to faculty professional training; 6) the existence of transformational leadership, may help in fostering innovation in Learning and Education for Sustainability.

5. Conclusions

This paper has shown examples from a set of universities, across the seven countries –one of which, namely Syria, currently suffering a long-standing conflict which has displaced millions of people-which showcase how sustainable development is being incorporated as part of university programmes.

The contribution of this paper to new knowledge is twofold. Firstly, it present concrete examples of transformative initiatives, also showing how sustainability can be implemented across contexts. Secondly, the paper shows that even though transformative approaches to enhance sustainability in the curricula are feasible and desirable, they require academics to develop collaborative approaches, for instance via working groups and Faculty learning communities, with open discussions about how to redesign courses, and foster the appreciation of epistemology of a multicultural vision in teaching and learning. This is admittedly, not an easy task. In addition, universities should pay more attention about the need to work towards integrating practice and theory, highlight in-service learning to promote teaching staff –and inter alia student-engagement through synergetic action and ethical discussions.

A whole university approach for embedding sustainability in HEI is also recommended. If in place, it may use teaching and learning, research, community engagement and general campus operations as tools for transformation in learning and education for sustainability. Reflections of the academics on their own values and support of universities to interdisciplinary collaboration between them is crucial for developing the transformative potential of students as agents and of a sustainable future.

References

Albrecht, P., Burandt, S., Schaltegger, S., 2007. Do sustainability projects stimulate organizational learning in universities? Int. J. Sustain. High Educ. 8 (4), 403–415. https://doi.org/10.1108/14676370710823573.

Argyris, C., Schön, D.A., 1996. Organizational Learning 2: Theory, Method, and Practice. Addison-Wesley, Reading, MA.

Bamber, P., Hankin, L., 2011. Transformative learning through service learning: no passport required. Educ + Train 53 (2/3), 190–206. https://doi.org/10.1108/00400911111115726.

Barber, N.A., Wilson, Venkatachalam, Cleaves, F., S.M, Garnham, J., 2014. Integrating sustainability into business curricula: university of New Hampshire case study. Int. J. Sustain. High Educ. 15 (4), 473–493. https://doi.org/10.1108/IJSHE-06-2013-0068.

Biedenweg, K., Monroe, M.C., Oxarart, A., 2013. The importance of teaching ethics of sustainability. Int. J. Sustain. High Educ. 14 (1), 6–14. https://doi.org/10.1108/14676371311288912.

Bilodeau, L., Podger, J., Abd-El-Aziz, A., 2014. Advancing campus and community sustainability: strategic alliances in action. Int. J. Sustain. High Educ. 15 (2), 157–168. https://doi.org/10.1108/IJSHE-06-2012-0051.

Bensahel, L., Roux, J., Zepf, M., 2014. Reveal, Plan, Share the Territory: the Student at the Heart of his Training. Tempus Project DEVETER. Campus Project.
Boni, A., Sastre, J.J., Calabuig, C., 2015. Educating Engineers for the Public Good Through International Internships: evidence from a Case Study at Universitat Politècnica de València. Sci. Eng. Ethics. https://doi.org/10.1007/s11948-015-9728-z.
Burford, G., Hoover, E., Velasco, I., Janoušková, S., Jimenez, A., Piggot, G., Podger, d, Harder, M.K., 2013. Bringing the "missing pillar" into sustainable development goals: towards intersubjective values-based indicators. Sustainability 5, 3035–3359. https://doi.org/10.3390/su5073035.
Burns, J.M., 2003. Transforming Leadership: a New Pursuit of Happiness. Atlantic, London ((3003).
Caetano, N., López, D., Cabré, J., 2015. Learning Sustainability and Social Compromise Skills: a New Track Is Born. ACM Press, New York.
Capozucca, P., Sarni, W., 2012. Sustainability 2.0 using sustainability to drive business innovation and growth. Deliotte Review 10, 139–147.
Cebrián, G., Grace, M., Humphris, D., 2015. Academic staff engagement in education for sustainable development. J. Clean. Prod. 106, 1–16. https://doi.org/10.1016/j.jclepro.2014.12.010.
Cocchiarella, F., Haley, D., Vargas, V.R., 2016. Fruitful Futures: Imagining Pomona. Gaia, Manchester.
Cortese, A., 2003. The critical role of higher education in creating a sustainable future. Plann. High. Educ. 31 (3), 15–22.
Dewey, J., 1933. Experience and Education. Macmillan Publishing Co, New York.
Disterheft, A., Caeiro, S., Azeiteiro, U.M., Leal Filho, W., 2015. Sustainable universities–a study of critical success factors for participatory approaches. J. Clean. Prod. 106, 11–21.
Dyment, J.E., Hill, A., 2015. You mean I have to teach sustainability too? Initial teacher education students' perspectives on the sustainability cross-curriculum priority. Australian Journal of Teacher Education 40 (3). https://doi.org/10.14221/ajte.2014v40n3.2.
Elkington, J., 1998. Cannibals with Forks: the Triple Bottom Line of 21st Century Business. New Society Publishers, Stony Creek.
Ferrer-Balas, D., 2004. Global environmental planning at the technical university of Catalonia. Int. J. Sustain. High Educ. 5 (1), 48–62, 0.1108/14676370410512580.
Ferrer-Balas, D., Buckland, H., de Mingo, M., 2009. Explorations on the University's role in society for sustainable development through a systems transition approach. Case study of the Technical University of Catalonia (UPC). J. Clean. Prod. 17 (12), 1075–1085. https://doi.org/10.1016/j.jclepro.2008.11.006.
Fernando, M., Langdown, A., Vargas, V., 2014. Incorporating Sustainable Wool Processing Using Engineering Solutions into the Academic Curriculum. Retrieved from. http://gdee.eu/images/Awards/Incorporating-Sustainable-Wool- Processing.pdf.
Fisher, P.B., McAdams, E., 2015. Gaps in sustainability education. Int. J. Sustain. High Educ. 16 (4), 407–423. https://doi.org/10.1108/IJSHE-08-2013-0106.
Gaziulusoy, A.I., Boyle, C., 2013. Proposing a heuristic reflective tool for reviewing literature in transdisciplinary research for sustainability. J. Clean. Prod. 48, 139–147. https://doi.org/10.1016/j.jclepro.2012.04.013.
Glassey, J., Haile, S., 2012. Sustainability in chemical engineering curriculum. Int. J. Sustain. High Educ. 13 (4), 354–364. https://doi.org/10.1108/14676371211262308.
Gudz, N.A., 2004. Implementing the sustainable development policy at the university of British Columbia. Int. J. Sustain. High Educ. 5 (2), 156–168. https://doi.org/10.1108/14676370410526242.
Holmberg, J., Lundqvist, U., Svanström, M., Arehag, M., 2012. The university and transformation towards sustainability. Int. J. Sustain. High Educ. 13 (3), 219–231. https://doi.org/10.1108/14676371211242544.
Hoover, E., Harder, M.K., 2014. What lies beneath the surface? The hidden complexities of organizational change for sustainability in higher education. J. Clean. Prod. 106, 175–188. https://doi.org/10.1016/j.jclepro.2014.01.081.
Howlett, C., Ferreira, J., Blomfield, J., 2016. Teaching sustainable development in higher education. Int. J. Sustain. High Educ. 173, 305–321. https://doi.org/10.1108/IJSHE-07-2014-0102.
Krizek, K.J., Newport, D., White, J., Townsend, A.R., 2012. Higher education's sustainability imperative: how to practically respond? Int. J. Sustain. High Educ. 13 (1), 19–33. https://doi.org/10.1108/14676371211190281.
Kumar, V., Gunasekaran, A., Singh, K., Papadopoulos, R., Dubey, T., 2015. Cross sector comparison of sustainability reports of Indian companies: a stakeholder perspective. Sustainable Production and Consumption 4, 62–71. https://doi.org/10.1016/j.spc.2015.08.005.
Kyburz-Graber, R., 2016. Case study research on higher education for sustainable development: epistemological foundation and quality challenges. In: Barth, M., Michelsen, G., Rieckmann, M., Thomas, I. (Eds.), Routledge Handbook on Higher Education for Sustainable Development. Routledge, London.
Lagnesjö, G., 2015. Shifting the Focus to People: Global Societal Priorities and the Contribution Made by Conservation Science, vol. 60, pp. 214–S219. https://doi.org/10.1080/00393630.2015.1117860.
Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainability Science 7 (S1), 25–43. https://doi.org/10.1007/s11625-011-0149-x.
Langdown, A., Vargas, V.R., 2015. Integrating sustainable development within teaching fashion education. In: Leal Filho, W., et al. (Eds.), Integrative Approaches to Sustainable Development at University Level. Springer International Publishing, pp. 539–550.
Lazzarini, B., Pérez-Foguet, A., Boni, A., 2018. Key characteristics of academics promoting Sustainable Human Development within engineering studies. J. Clean. Prod. 188, 237–252. Available at: https://www.sciencedirect.com/science/article/pii/S095965261830951X?via%3Dihub [Accessed April 29, 2018].
Leal Filho, W., 2015. Education for sustainable development in higher education: reviewing needs. In: Filho, Leal, Kuznetsova, Brandli (Eds.), (2015) Transformative Approaches to Sustainable Development at Universities. Springer International Publishing.
Leal Filho, W., Brandli, L., Kuznetsova, O., 2015a. Integrative Approaches to Sustainable Development at University Level. Springer International Publishing, Berlin.
Leal Filho, W., Manolas, E., Pace, P., 2015b. The future we want. Int. J. Sustain. High Educ. 16 (1), 112–129. https://doi.org/10.1108/IJSHE-03-2014-0036.
Leithwood, K., Jantzi, D., 2006. Transformational school leadership for large-scale reform: effects on students, teachers and classroom practices. Sch. Effect. Sch. Improv. 17 (2), 201–227. Available at: http://www.tandfonline.com/doi/abs/10.1080/09243450600565829.
Lewin, K., 1951. In: Cartwright, D. (Ed.), Field Theory in Social Science; Selected Theoretical Papers. Harper & Row, New York, NY, USA.
Loncar, J., 2011. Obrazovanje za odrzivi razvoj na fakultetima drustveno –humanisickih nauka. In: Pavlovic, V. (Ed.), Univerzitet I Odrzivi Razvoj. Fakultet politickih nauka, Beograd, pp. 241–263.
Lotz-Sisitka, H., 2010. Knowing question associate with the public health and climate change relation: some implications for universities in Southern Africa. In: Kotecha, P. (Ed.), Climate Change, Adaptation and Higher Education: Securing Our Future, Sarua Leadership Dialogue Series, vol. 2. South African Regional Universities Association, Wits, South Africa. No.4.
Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, F.J., Waas, T., Lambrechts, W., Lukman, R., Hugé, J., 2015. A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. J. Clean. Prod. 108, 1–18. https://doi.org/10.1016/j.jclepro.2014.09.048.
Marques, W.A., Maruyama, Ú.G.R., Maciel, M.S.D., 2013. Abordagens Educacionais para a Inovação: Estudo sobre a Perscpectiva dos Estudantes de Ensino Técnico sobre Inovação na Educação Tecnológica. Disponível em. http://www.academia.edu/download/33663532/4.CNEG_2013_PIBIC_EM_T13_0655_3350.pdf.
Max-Neef, M.A., 2005. Foundations of transdisciplinarity. Ecol. Econ. 53 (1), 5–16. https://doi.org/10.1016/j.ecolecon.2005.01.014.
Mezirow, J., 1997. Transformative learning: theory to practice. N. Dir. Adult Cont. Educ. 74, 5–12.
Mezirow, J., 2000. Learning as Transformation: Critical Perspectives on a Theory in Progress. Jossey Bass, San Francisco.
Miller, T.R., Muñoz-Erickson, T., Redman, C.L., 2011. Transforming knowledge for sustainability: towards adaptive academic institutions. Int. J. Sustain. High Educ. 12 (2), 177–192. https://doi.org/10.1108/14676371111118228.
Mochizuki, Y., Fadeeva, Z., 2010. Competences for sustainable development and sustainability. Int. J. Sustain. High Educ. 11 (4), 391–403. https://doi.org/10.1108/14676371011077603.
Moore, J., 2005. Seven recommendations for creating sustainability education at the university level. Int. J. Sustain. High Educ. 6 (4), 326–339. https://doi.org/10.1108/14676370510623829.
Moore, J., 2005b. Barriers and pathways to creating sustainability education programs: policy, rhetoric and reality. Environ. Educ. Res. 11 (No. 5), 537–555. https://doi.org/10.1080/13504620500169692.
Mulder, K.F., Segalàs, J., Ferrer-Balas, D., 2012. How to educate engineers for/in sustainable development. Ten years of discussion, remaining challenges. Int. J. Sustain. High Educ. 13 (3), 211–218. https://doi.org/10.1108/14676371211242535.
Nadic, D., 2011. Mesto I Uloga Obrazovanja Za Odrzivi Razvoj U Obrazovanju Politikologa, U Pavlovic, Beograd.
Natkin, L.W., Kolbe, T., 2016. Enhancing sustainability curricula through faculty learning communities. Int. J. Sustain. High Educ. 17 (4), 540–558. https://doi.org/10.1108/IJSHE-02-2015-0024.
Oliveira, K.C.C., 2017. Relacionando Liderança Transformacional e Inovação na Educação. Dissertação de Mestrado. Mestrado em Empreendedorismo e Internacionalização. 2017. Instituto Superior de Contabilidade e Administração do Porto.
Orlovic-Lovren, V., 2016. University teachers in transition towards sustainability: one concept and numerous questions. Innovacije u nastavi (Innov. Teach.) XXIX (2016/4), 123–139.
Orlovic-Lovren, V., Maruna, M., Crncevic, T., 2016. Contributing towards more sustainable cities -learning through collaboration. In: Leal-Filho, W., Brandli, L. (Eds.), Engaging Stakeholders in Education for Sustainable Development at University Level, World Sustainability Series. Springer International Publishing.
Orlovic-Lovren, V., 2015. Integrating sustainability into the curriculum of adults: a journey across disciplines. In: Leal Filho, W., et al. (Eds.), Integrative Approaches to Sustainable Development at University Level: Making the Links. Springer, Berlin.
Ortega-Sánchez, M., Moñino, A., Bergillos, R.J., Magaña, P., Clavero, M., Díez-Minguito, M., Baquerizo, A., 2018. Confronting learning challenges in the field of maritime and coastal engineering: towards an educational methodology for sustainable development. J. Clean. Prod. 171, 733–742.
Pantelic, A., 2011. Odrzivim Navikama Do Odrzivog Razvoja U Pavlovic. Univerzitet iodrzivi razvoj, Beograd.
Pavlović, V., 2011. Fakultet Političkih Nauka, Beograd. People and Planet Green

League. Retrieved from. https://peopleandplanet.org/university-league/2015/tables?uni=11329.
Pérez-Foguet, A., Oliete-Josa, S., Saz-Carranza, A., 2005. Development education and engineering: a framework for incorporating reality of developing countries into engineering studies. Int. J. Sustain. High Educ. 6 (3), 278–303. https://doi.org/10.1108/14676370510607241.
Pérez-Foguet, A., Lazzarini, B., Giné, R., Velo, E., Boni, A., Sierra-Castañer, M., Zolezzi, G., Trimingham, R., 2018. Promoting sustainable human development in engineering: Assessment of online courses within continuing professional development strategies. J. Clean. Prod 172, 4286–4302. https://doi.org/10.1016/j.jclepro.2017.06.244.
Ramos, T.B., Caeiro, S., van Hoof, B., Lozano, R., Huisingh, D., Ceulemans, K., 2015. Experiences from the implementation of sustainable development in higher education institutions: environmental Management for Sustainable Universities. J. Clean. Prod. 106, 3–10. https://doi.org/10.1016/j.jclepro.2015.05.110.
Remington-Doucette, Connell, S.M., Armstrong, K.Y.H., Musgrove, C.M., S.L, 2013. Assessing sustainability education in a transdisciplinary undergraduate course focused on real-world problem solving: a case for disciplinary grounding. Int. J. Sustain. High Educ. 14 (4), 404–433. https://doi.org/10.1108/IJSHE-01-2012-0001.
Ryan, A., Cotton, D., 2013. Times of change: shifting pedagogy and curricula for future sustainability. In: Sterling, S., Maxey, L., Luna, H. (Eds.), The Sustainable University: Progress and Prospects. Routledge, London.
Sammalisto, K., Sundström, A., Holm, T., 2015. Implementation of sustainability in universities as perceived by faculty and staff – a model from a Swedish university. J. Clean. Prod. 106, 45–54. https://doi.org/10.1016/j.jclepro.2014.10.015.
Savelyeva, T., 2012. Escaping the structural trap of sustainability in academia through global learning environments. In: Battels, K.A., Parker, K.A. (Eds.), Teaching Sustainability/teaching Sustainably. Stylus. Sterling, Virginia.
Schafersman, S., 1991. Introduction to Critical Thinking. Retrieved from. http://facultycenter.ischool.syr.edu/wp-content/uploads/2012/02/Critical-Thinking.pdf.
Senge, P., 1990. The Fifth Discipline: The Art & Practice of the Learning Organization. Doubleday, New York, NY, USA.
Shnayder, L., van Rijnsoever, F.J., Hekkert, M.P., 2016. Motivations for Corporate Social Responsibility in the packaged food industry: an institutional and stakeholder management perspective. J. Clean. Prod. 122, 212–227. https://doi.org/10.1016/j.jclepro.2016.02.030.
Sterling, S., 2013. The sustainable university: challenge and response. In: Sterling, S., Maxey, L., Luna, H. (Eds.), The Sustainable University: Progress and Prospects. Routledge, London.
Thomas, I., 2016. Challenges for implementation of education for sustainable development in higher education institutions. In: Barth, M., Michelsen, G., Rieckmann, M., Thomas, I. (Eds.), Routledge Handbook on Higher Education for Sustainable Development. Routledge, London.
Tinker, H., Tzoulas, K., 2015. The benefits and challenges of developing and implementing an environmental management system using a participatory approach: a case study of Manchester Metropolitan University, UK. In: Leal Filho, W., et al. (Eds.), Integrating Sustainability Thinking in Science and Engineering Curricula. Springer International Publishing, Berlin, pp. 425–438.
Too, L., Bajracharya, B., 2015. Sustainable campus: engaging the community in sustainability. Int. J. Sustain. High Educ. 16 (1), 57–71. https://doi.org/10.1108/IJSHE-07-2013-0080.
Trimingham, R., Lazzarini, B., Pérez-Foguet, A., Noble, N., Boni, A., Sierra-Castañer, M., Mongera, F., Zolezzi, G., 2016. Global dimensions in engineering education: experiences from a collaborative project. In: Leal, W., Pace, P. (Eds.), Teaching Education for Sustainable Development at University Level. Springer.
Velazquez, L., Munguia, N., Platt, A., Taddei, J., 2006. Sustainable university: what can be the matter? J. Clean. Prod. 14, 810–819. https://doi.org/10.1016/j.jclepro.2005.12.008.
Von Blottnitz, H., Case, J.M., Fraser, D.M., 2015. Sustainable development at the core of undergraduate engineering curriculum reform: a new introductory course in chemical engineering. J. Clean. Prod. 106, 300–307. https://doi.org/10.1016/j.jclepro.2015.01.063.
Wade, R., 2013. Promoting sustainable communities locally and globally: the role of regional Centres of Expertise (RCEs). In: Sterling, S., Maxey, L., Luna, H. (Eds.), The Sustainable University: Progress and Prospects. Routledge, London.
Watson, M.K., Lozano, R., Noyes, C., Rodgers, M., 2013. Assessing curricula contribution to sustainability more holistically: experiences from the integration of curricula assessment and students' perceptions at the Georgia Institute of Technology. J. Clean. Prod. 61, 106–116. https://doi.org/10.1016/j.jclepro.2013.09.010.
Wiek, A., Xiong, A., Brundiers, Leeuw, K., S.V.D, 2014. Integrating problem - and project-based learning into sustainability programs: a case study on the School of Sustainability at Arizona State University. Int. J. Sustain. High Educ. 15 (4), 431–449. https://doi.org/10.1108/IJSHE-02-2013-0013.
Wooltorton, S., Wilkinson, A., Horwitz, P., Bahn, S., Redmond, Dooley, J., J, 2015. Sustainability and action research in universities. Int. J. Sustain. High Educ. 16 (1), 424–439. https://doi.org/10.1108/IJSHE-09-2013-0111.